

INDUSTRIAL LEAD POISONING.

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THE principal data which form the basis of the present paper were tabulated by the writer for the Annual Report of the Chief Inspector of Factories for 1899, and were obtained as a result of an enactment in the Factories and Workshops Act of 1895. This enactment requires every medical practitioner attending on or called in to visit a patient whom he believes to be suffering from lead poisoning, contracted in a factory or workshop, to notify the case forthwith to the Chief Inspector of Factories at the Home Office; and a similar obligation is imposed on the occupier of a factory or workshop to send written notice of every such case to the Certifying Surgeon and Inspector of Factories for the district.

In form there is close similarity between this section and that in the Infectious Diseases (Notification) Act requiring the medical practitioner and householder to notify the medical officer of health of every case of scarlet fever, diphtheria, etc. It is common knowledge that as regards the householder this enactment has been allowed to become a dead letter (although it still remains on the statute) because he is thereby credited with medical knowledge which cannot be expected of him. The case of the occupier of a factory is perhaps not quite on all fours with that of the householder, because, employing persons as he does for his own profit on work in which lead is used, his duty to take every practicable precaution is apparent, and should the injurious effects of lead show themselves in one of the workers his share in the responsibility for this must, within reason, be brought home to him.

As one main object of notification under the Infectious Diseases (Notification) Act is to protect the community against a scourge such as

diphtheria, so repeated notifications of lead poisoning in the same trade may lead to the institution of special regulations for the industry as a whole. As a matter of routine, a notification leads to an inquiry to see whether regulations already in force have been infringed in the particular workplace or not, and as to how far there may have been contributory negligence on the part of the sufferer.

In scarlet fever, in small-pox, etc. the symptoms are, within well-recognised limits, precise; in lead poisoning the differential diagnosis has or ought to be made from a variety of the commonest every-day ailments—headache, anaemia, rheumatism, abdominal pain. In the diseases notifiable under the Infectious Diseases (Notification) Act the patient is almost invariably laid up in bed, whereas in lead poisoning notification is not infrequently made of persons who do not lose a single day's work. There is no standard of what constitutes lead poisoning just as there is no standard of what constitutes ptomaine poisoning, or poisoning by arsenic or mercury. But common sense points to the desirability of fixing in some way the degree of the severity of symptoms which should lead to notification, and there are few medical men probably who would deny that symptoms, the result of the absorption of lead, or arsenic, or mercury, necessitating absence from work, should at any rate constitute sufficient grounds for this.

The notification of the practitioner gives as a rule no indication of symptoms beyond his belief that the case is one of lead poisoning. Details as to these are obtained by examination a day or two later of the patient by the Certifying Surgeon; and the tables which follow are based entirely on an analysis of these reports. In from ten to fifteen per cent. of the cases he is unable to confirm the diagnosis. These cases are marked doubtful, but with a very few exceptions where the evidence against lead poisoning is conclusive are all included in the return. This accounts to some extent for what may be considered the unduly large number of cases in which the severity of the symptoms and the number of the attack appear in the "not stated" column, and the symptoms are recorded as "uncertain." With a malady then showing such extraordinary range in severity as lead poisoning, and attended with such difficulty in diagnosis, a tabulation only of the number reported as so suffering conveys hardly any useful information. It is when the cases are carefully analysed, distinguished according to their severity, to the length of time of exposure to the injurious action of lead, to the number of previous attacks, to the nature of the symptoms, and to the precise occupation that their true value is brought out. If the figures given

are the first of their kind and to be accepted therefore with reservation any doubt attaching to them will be dispersed by the experience of similar figures in future years.

The following table (p. 100) relates to 1130 cases of lead poisoning reported upon by Certifying Surgeons in 1899. It does not include the cases that were notified as occurring among house painters and plumbers for the reason that to these workers the provisions of the Factory Acts do not in general apply, nor does it include a small number of persons notified who for one reason or another could not be traced. The total number of cases of lead poisoning included in the published returns in 1899 as having been contracted in a factory or workshop was 1258.

The reports upon which this table is based describe not only the particular attack but also the general condition of the patient at the time of the attack. Colic is as a rule the symptom which leads to notification, but if on examination old-standing paralysis is found the Certifying Surgeon makes mention of it in his report. This has led in a few cases to anomalies in the column as to "severity," for if the particular attack was slight, even although paralysis was present, the "severity" might be described as slight. It would seem desirable to regard the general condition of the worker rather than the symptoms of the particular attack as the basis of the description "severity" so far as this may be attributable to lead. The personal element of course enters into the report. Symptoms which one certifying surgeon regards as slight, another might consider moderate or even severe. All cases which were marked "fairly severe" or "rather severe" were classed under the heading "severe." Some error may have entered into the description of symptoms as "moderate," for all cases which were reported as "not severe" (obviously they must have been moderate or slight) were classed under that heading.

Very frequently a combination of symptoms is given, and when this is the case each one of them has been entered. The total number of symptoms, therefore, considerably exceeds the number of reported cases, but this does not interfere with the correctness of the estimate of each one as a percentage on the total number reported.

It need hardly be said that the symptoms are usually very shortly described, and the reports therefore are very different from the accurate description of cases to be found in hospital records. They will not admit, for example, where paralysis is mentioned, except rarely, of further tabulation according to the precise group of muscles affected.

A fuller description of the main symptoms could have been given for each one of the industries named. I only give it for the total number of cases reported because I cannot believe that in all cases, as for instance among white lead workers, the symptoms of anaemia, headache, and arthralgia are recorded as often as they must have been present, and I regard therefore the figures given under these heads as too low.

MAIN SYMPTOMS REFERABLE TO LEAD.

	Digestive		Anaemia		Headache		Paretic		Encephalo- pathic		Rheum- atic		Uterine	Uncertain	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	F.	M.	F.
Total	763	119	107	37	59	42	129	13	35	8	58	8	7	64	17
Per cent. of reported cases	80·0	67·6	11·2	21·0	6·2	23·9	13·5	7·4	3·7	4·5	6·0	4·5	4·0	6·7	9·7

Under smelting are included no less than 28 cases among workers in spelter, where the proportion of lead in the zinc is usually less than 5 per cent. The poisoning is attributable to fumes containing probably oxide and sulphide of lead. In printing, file-cutting, and plumbing, the handling of, or inhalation of dust from, metallic lead is the source of the poisoning. By far the largest number of cases of plumbism are found in the next group of industries, and are attributable in great measure to the inhalation of the dust from the manufacture of carbonate of lead in white lead factories; to the use of white lead in the glazes required in china and earthenware works and enamelling of iron plates; to its use in the putty powder required in glass polishing; and to the grinding of white lead in the manufacture of paints and colours. The inhalation of the dust from the red oxide of lead is responsible for most of the cases in electrical accumulator works. In ship-building also the indispensable qualities which red lead paint possesses of forming a durable coat for iron plates causes it to be much used with as a result a certain amount of lead poisoning.

The table as arranged is capable of showing the amount and degree of poisoning arising from fumes, from handling lead, from salts of lead in the form of dust, and from salts of lead in the form of paint. Bearing in mind as involving a possible fallacy that the figures do not take into account the duration of employment, but include chronic cases as well as first attacks, they certainly seem to show that the slower and more insidious form of lead poisoning brought about by the handling of

ANALYSIS OF REPORTS ON LEAD POISONING

Occupation	Severity of Symptoms									
	Severe		Moderate		Slight		Not stated		Total	
	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
Smelting	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	9	—	18	—	24	—	1	—	52	—
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	17·3	—	34·6	—	46·2	—	2·0	—	—	—
Brass	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	5	—	1	—	4	1	1	—	11	1
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Sheet-lead	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	11	—	5	—	10	—	—	—	26	—
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	44·3	—	19·2	—	38·5	—	—	—	—	—
Printing	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	7	—	6	1	8	—	4	—	25	1
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	28·0	—	24·0	—	32·0	—	16·0	—	—	—
File-cutting	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	21	1	3	—	12	—	3	—	39	1
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	53·9	—	7·7	—	30·8	—	7·7	—	—	—
Plumbing	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	7	—	2	—	5	1	2	—	16	1
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Tinning and enamelling of iron holloware	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	5	1	2	1	4	2	—	—	11	4
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
White lead	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	79	3	22	—	232	17	7	2	340	22
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	23·2	13·6	6·5	—	68·3	77·3	2·1	9·1	—	—
Red lead	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	6	—	3	1	9	—	1	1	19	2
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Earthenware	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	35	22	16	18	62	67	6	4	119	111
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	29·4	19·8	13·4	16·2	57·1	60·4	5·0	3·6	—	—
Litho-transfers	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	2	1	—	2	3	1	1	—	6	4
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Glass	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	2	1	1	—	4	—	—	—	7	1
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Enamelling of iron plates	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	2	1	1	2	3	1	—	—	6	4
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Electric accumulators	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	8	1	4	—	19	—	—	—	31	1
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Paints and colours	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	20	—	7	—	16	1	4	—	47	1
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	42·5	—	14·9	—	34·0	—	8·5	—	—	—
Coach-painting, &c.	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	25	—	9	—	17	—	7	—	58	—
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	43·1	—	15·5	—	29·3	—	12·1	—	—	—
Ship-building	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	6	—	8	—	16	—	—	—	30	—
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	20·8	—	26·7	—	53·3	—	—	—	—	—
Paint in other industries, excluding house-painters	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	24	1	10	1	11	3	2	—	47	5
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	51·1	—	21·3	—	23·4	—	4·3	—	—	—
Other industries	{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...		{ No. of cases ...	
	22	5	12	5	26	3	4	4	64	17
	{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...		{ Per cent. ...	
	—	—	—	—	—	—	—	—	—	—
Total	306	37	130	31	485	96	43	11	954	176
Per cent. of reported cases ...	32·0	21·0	13·6	17·6	50·8	54·5	4·5	6·3	—	—

BY CERTIFYING SURGEONS IN 1899.

Number of Attack								Main Symptoms referable to Lead							
1st		2nd		3rd, or Chronic		Not stated		Digestive		Paretic		Encephalo- pathic		Uncertain	
M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
27	—	13	—	11	—	1	—	42	—	11	—	—	—	1	—
51·9	—	25·0	—	21·2	—	2·0	—	80·8	—	21·2	—	—	—	2·0	—
8	1	1	—	1	—	1	—	7	—	4	—	—	—	1	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
14	—	6	—	4	—	2	—	19	—	7	—	1	—	—	—
53·9	—	23·1	—	15·4	—	7·7	—	73·1	—	26·9	—	3·8	—	7·7	—
15	—	5	1	2	—	3	—	14	—	6	1	2	—	—	—
60·0	—	20·0	—	8·0	—	12·0	—	56·0	—	24·0	—	8·0	—	20·0	—
11	1	9	—	15	—	4	—	21	—	17	—	4	—	2	—
28·2	—	23·1	—	38·5	—	10·3	—	53·9	—	43·6	—	10·3	—	5·1	—
9	1	2	—	4	—	1	—	7	—	3	—	—	—	4	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
5	2	4	1	2	1	—	—	11	—	4	—	—	—	1	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
277	14	38	3	15	2	10	3	292	17	19	1	17	—	13	4
81·5	63·6	11·2	13·6	4·4	9·1	2·9	13·6	85·9	77·3	5·6	—	5·0	—	3·8	—
14	—	4	—	—	—	1	—	17	—	5	—	—	—	1	1
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
66	84	30	10	20	8	3	9	89	77	11	6	6	7	7	10
55·5	75·7	25·2	9·0	16·8	7·2	2·5	8·1	74·8	69·4	9·2	5·4	5·0	6·3	5·9	9·0
3	2	2	2	—	—	1	—	5	4	—	—	1	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
4	—	—	—	3	1	—	—	6	—	1	1	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	2	—	2	—	—	—	—	6	3	—	—	—	—	—	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
24	1	4	—	2	—	1	—	30	—	2	—	—	—	1	—
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	1	11	—	5	—	2	—	45	1	7	—	2	—	2	—
61·7	—	23·4	—	10·6	—	4·3	—	95·8	—	14·9	—	4·3	—	4·3	—
20	—	5	—	26	—	7	—	43	—	10	—	—	—	11	—
34·5	—	8·6	—	44·8	—	12·1	—	74·2	—	17·2	—	—	—	19·0	—
27	—	2	—	1	—	—	—	28	—	3	—	—	—	—	—
90·0	—	6·7	—	3·3	—	—	—	93·4	—	10·0	—	—	—	—	—
21	3	10	1	14	1	2	—	34	3	10	—	2	—	5	1
44·7	—	21·3	—	29·8	—	4·3	—	72·3	—	21·3	—	4·3	—	10·6	—
13	10	6	4	13	1	3	2	47	12	9	1	—	1	6	1
—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
623	122	152	24	138	14	42	14	763	119	129	13	35	8	62	17
65·3	69·3	16·0	13·6	14·4	7·9	4·4	7·9	80·0	67·6	13·5	7·4	3·7	4·5	6·5	9·7

metallic lead and the absorption of the salts of lead in the form of paint is more severe in the long run than that brought about by salts of lead in the form of dust or from fumes.

Comparing the figures for smelting as representing fumes, the combined totals for sheet lead and printing as representing handling, white lead, and china and earthenware as representing dust, and coach-painting, ship-building, and paint used in other industries as lead salts in the form of paint, it will be seen that the percentage of severe cases is much greater in the handling of lead and in painting.

	Severity of Symptoms				Number of Attacks				Main Symptoms		
	Severe	Moderate	Slight	Not stated	1st	2nd	3rd, or chronic	Not stated	Digestive	Paretic	Indefinite or not stated
Fumes ...	17.3	34.6	46.2	2.0	51.9	25.0	21.3	2.0	80.8	21.2	2.0
Dust ...	24.6	8.4	64.6	2.4	75.4	14.9	7.7	2.9	83.8	6.6	4.4
Metallic lead	34.6	21.2	34.6	7.7	55.8	21.2	11.5	9.6	63.5	25.0	13.5
Paint ...	40.7	20.0	32.6	6.7	50.4	12.6	30.4	6.7	77.8	17.0	11.9

The reports bring out very clearly remarkable differences in the average age of those attacked in one and another industry and the average length of time spent in it—points which are of moment when the question of administrative interference arises. Thus taking three industries, china and earthenware, white lead, and file cutting, the age distribution of the persons attacked and the average duration of employment prior to the particular attack for which they were reported is as follows:—

	Age distribution		Duration of employment	
	Under 30 years	30 and over	Under 5 years	5 and over
China and Earthenware per cent.	59.4	40.6	52.2	47.8
White lead	45.7	54.3	86.8	13.2
File-cutting	22.9	77.1	—	100.0

If the figures for all persons attacked in the china and earthenware industry were examined still more closely and distributed according to sex they would show that men continue to work in lead a much longer time than do women. In that industry, for example, of the total number of females reported in 1898, 69 per cent. were attacked before their thirtieth year and 31 per cent. after; whereas in males the numbers were 46 per cent. and 54 per cent. respectively.

The slowness of the onset of symptoms in the case of file-cutters and of those engaged in painting produces probably in the workers a feeling of indifference to the gradual undermining of the constitution, whereas sharp attacks of colic occurring among white lead and pottery workers cause some of them to seek other employment. This is borne out by the column referring to "number of attack" which shows that in white lead works, in paint and colour works, and in females in china and earthenware there is a far greater number of first attacks than there is in the case of file-cutters and painters. This means a constant influx of new hands in the one case which is absent in the other. The figures as to the duration of employment of those attacked in white lead works (13 per cent. only having worked for 5 years and over) stamp it at once as an industry so fraught with danger that not many will continue to work in it for long. A rule giving power to the Certifying Surgeon to suspend temporarily or permanently from employment any person who he thinks incurs grave risk by continuing in his work can inflict little hardship where the age of the workers is low or in an industry like white lead, where the employment is largely casual, but in file-cutting when 77 per cent. are over 30 years of age to enforce such a rule might be attended with more difficulty.

The figures in the main table and in the subsidiary table on "Main Symptoms" do not contribute much to the solution of the question as to whether women are more susceptible to the effects of lead than men. No doubt the symptoms of headache and anaemia and possibly encephalopathy occur in women more frequently than in men. Saturnine palsy, however, is essentially an affection of the male sex, and the figures support the conclusion that the proportion of severe attacks is greater in males than in females.

Evidence on this point can be obtained in another way. In June 1898 the employment of women in the dangerous processes of the white lead manufacture was prohibited and men took their place. In the six months preceding the change in the district of Newcastle 19 males and 66 females were reported as compared with 82 males and 12 females in the succeeding six months. The number of reported cases of lead poisoning in white lead works in 1899 shows further a regrettable increase (possibly due to increased notification of slight attacks) as compared with previous years. These figures, therefore, do not lead to the conclusion that females are more susceptible to lead than males.

The influence of lead on the child-bearing function is of immense

importance, and the following statistics are valuable as being the result of careful personal inquiry into this subject by Miss Paterson and Miss Deane, two of H.M. Inspectors of Factories¹.

“Out of the 77 married women reported during this period [the year ending March 31st, 1897] 15 have been childless and have had no miscarriages; 8 have had 21 still-born children; 35 have had 90 miscarriages, and of these 15 have had no child born; 36 have had 101 living children, of whom 61 are still alive, the great majority of the 40 who are dead have succumbed to convulsions in infancy.”

Mr J. F. Arlidge, Certifying Surgeon for the district of Stoke, has kindly placed at my disposal some very interesting figures on this aspect of plumbism, the result of inquiries made by him of 239 married women working in lead processes in the china and earthenware industry.

From each woman he has obtained facts as to the number of children born, the number of these who have died, and the number of miscarriages in the two periods, (1) previous to lead employment, and (2) during or after employment in lead. He has also tabulated the ages at death and the cause of death (whenever possible) of the children, the number of years of work in lead, and the precise occupation. The figures admit only of general comparison, for to make this accurate it would be necessary to know the potential child-bearing power at each of the two periods in the case of every woman.

The general facts from his figures may be tabulated as follows:

No. of Women	Previous to lead employment				During or after lead employment			
	Children		Pregnancies		Children		Pregnancies	
	Born	Died	Total	Miscarriages	Born	Died	Total	Miscarriages
239	453	183	487	34	499	182	566	67
	100	40·4	100	7·0	100	36·5	100	11·8

The percentage of children who died to the total number born is greater, and the percentage of miscarriages to the total number of pregnancies considerably less, in the period before lead employment than in the period of lead employment.

Mr Arlidge has distinguished miscarriages from premature births and has limited the term miscarriage to premature expulsion of the ovum at any time up to 6½ months of pregnancy. Among the 183 children who died in the period prior to lead employment are included

¹ Annual Report of the Chief Inspector of Factories for the year 1897, p. 53.

14 premature births (7·6 per cent.) and 11 still births (6·0 per cent.), as compared with 17 premature births (9·3 per cent.) and 21 still births (11·5 per cent.), among the 182 who died in the subsequent period. The percentage proportion of still births in the two periods is, therefore, very similar to that of miscarriages as given in the table. There died of convulsions in the period prior to lead employment 33 children (18·0 per cent.), and in that during or after it 28 (15·3 per cent.)—figures which tend to disprove the view that there is special incidence of convulsions on the children of lead workers. Before commencing work in lead 21 of the women had miscarried—a number which is increased to 34 afterwards. Four miscarried in both periods.

Eleven of the 34 miscarriages recorded in the first period were confined to 3 women, and 20 of the 67 recorded in the second also to 3 women. If these extreme cases are excluded the percentage of miscarriages to the total number of pregnancies is reduced to 5·0 and 8·7 respectively. The *proportion* in the two periods, however, remains practically unaltered.

Among the 239 women there were 71 who had had no children prior to work in lead, and in whom the duration of employment had been 10 years and over. It may be assumed, therefore, for them that the whole of their married life was cotemporaneous with work in lead, and that in many of them the full measure of fertility had been reached. These 71 women had 302 children (of whom 114 died), and 38 miscarriages, that is, for every 100 children born 37·7 died and 11·1 of every 100 pregnancies resulted in miscarriage.

The number of miscarriages to pregnancies is variously put at from 1—5 to 1—8 or 10. Whitehead from a series of 2000 hospital cases, *i.e.* wage-earners, puts it at 1—7¹. Miss Paterson's and Miss Deane's figures for the 77 notified cases makes the proportion 1—2·3; Mr J. F. Arlidge's for these 71 women working in lead 1—9, and for the whole 239 women prior to lead employment 1—14.

Disuse of lead has recently been found practicable in the hands of some manufacturers in glazes used for the enamelling of iron plates; a spelter bed has been substituted for the leaden bed formerly used in the manufacture of machine-made files; rouge or oxide of tin has been able to replace putty powder in several branches of the glass-polishing industry; yellow and orange aniline dyes have to a large extent taken the place of the yellow and orange chromates of lead in yarn dyeing. Leadless glazes in china and earthenware are on trial,

¹ See *The Causes and Treatment of Abortion*, by R. R. Rentoul, pp. 2—5.

but in this industry the substitution of an almost insoluble double silicate for the carbonate in the glaze seems likely to effect a very material mitigation of the danger.

The description holds good to-day which Tanquerel des Planches¹ wrote in 1838 of the superiority of white lead paint over any other kind: "(1) elle se mêle facilement à l'huile, (2) elle conserve sa couleur dans cette union, (3) elle s'étend aisément sous le pinceau, (4) elle s'applique exactement sur la surface qu'on veut enduire, (5) elle prête le corps convenable et la faculté de sécher promptement aux autres couleurs, (6) elle n'est altérable ni par l'air ni par l'eau; aussi elle préserve le bois de toute corruption"—and only here and there can other substitutes such as zinc white take its place.

The uses of lead and lead compounds have been so long known and the methods of manufacture have undergone so little change that they continue to be carried on often in the same building which served a like purpose a century ago when the value placed on human health was not what it is to-day. Persons exposed to lead with its anaemia-producing effect want sunlight and air which structural conditions often allow to enter but sparingly.

It is unnecessary to insist on cleanliness or of the ample facilities which should be provided for this on the part of the occupier. Mere cleanliness of the hands, however, is not enough where there is question of lead dust. There must be cleanliness in detail of the nails, of the teeth, and of the clothing. And to meet these by the provision of nailbrushes, overalls, and head coverings is not enough. There should be in addition a periodical medical examination at stated times, with power to the appointed surgeon to suspend temporarily or permanently from work those who he thinks are specially susceptible.

The following extract on this point from the suggestions² to such surgeons as have been appointed for this work in white lead factories and china and earthenware works may prove useful:

The necessity for notification does not arise until lead poisoning is diagnosed, and, in general, not unless the symptoms are of such a nature as to require abstention from work, but in deciding the question of suspension or fitness for work in lead other considerations come in. Liability to injurious effects may be indicated by present or past attacks of lead poisoning, by tendency to epilepsy, by marked anaemia not necessarily due to lead, by careless personal habits, such as want of attention to cleanliness of hands and teeth or of clothing, or biting of nails,

¹ *Traité des Maladies Saturnines*, Paris, 1839, Vol. i. p. 123.

² *Memorandum on Industrial Lead Poisoning*, Home Office, 1898.

or taking food in prohibited places, or neglect of other precautions prescribed by Special Rules. Indirectly, shortsightedness predisposes to danger, by causing undue proximity to the work. In women the question of pregnancy has to be borne in mind.

Where the diagnosis is clearly established there should be no hesitation in ordering suspension. Whether the predisposing cause in such instances be natural susceptibility or merely careless habits, the unfitness for work in lead is equally obvious.

Occasionally a case will present itself to the Certifying Surgeon, at the monthly or weekly examination, in which the symptoms are so marked as to warrant notification as well as suspension from work. Such cases should obviously be distinguished from those in which the symptoms are so pronounced that medical attendance is sought by the patient at his home or at hospital, and a note should accordingly be made on the report form.

Short of suspension, conditions are met with which call for a caution to the workers, and careful observation month by month on the part of the Certifying Surgeon. In like manner special attention should be directed at the monthly examination to those who have been allowed to resume work in lead processes after an attack of plumbism, to those who present equivocal symptoms in any way suggesting plumbism, to those who have a marked blue line, and to women workers who are pregnant.

The value of the periodic examination in impressing upon the workpeople the importance of habits of cleanliness, and of attention to the prescribed rules, cannot be too strongly insisted upon, and it would be well if the Certifying Surgeon, in reporting on notified cases, were, as a matter of routine, to note whether from his observation of the home surroundings and general appearance of the patients, as well as from their replies, he is able to draw any conclusion as to their exercise of reasonable care.

The duration of suspension from work rests with the discretion of the Certifying Surgeon. In general, it may be said that a temporary suspension should suffice in cases of slight and transient attack, but repeated or grave attacks call for prolonged abstinence from work in lead, and usually for discontinuing it altogether.

It is illegal under section 17, 1891, for a woman to be employed in any factory or workshop within four weeks after confinement; and where the work is such as to involve the grave additional risk of plumbism a longer interval becomes necessary.

This periodical medical examination should not be lightly undertaken. It places grave responsibilities on the surgeon, and its effect for good will depend entirely upon his appreciation of them. In the out-patient room of a hospital a patient comes to tell his symptoms—at a factory the condition has to be judged of sometimes in the face of deliberate misstatements. Hence mere questioning will fail to secure the full benefit from the provision unless every other means for the diagnosis of incipient plumbism is called in aid, such as examination of the condition of the teeth and gums, of the pupils and muscles of the eye, of the colour of the conjunctiva, of the presence or

not of tremor or hysteria, and of the resistance of the extensors of the wrist to forcible flexion.

The question of the removal of lead dust by mechanical means and the practicability of respirators as a means of protection against it opens up a field too wide to enter on here, suffice it to say that while reliance has to be placed less and less on the use of respirators, every day sees improved conditions of work brought about by the introduction of fans so arranged as to catch the dust at the point where it is produced.